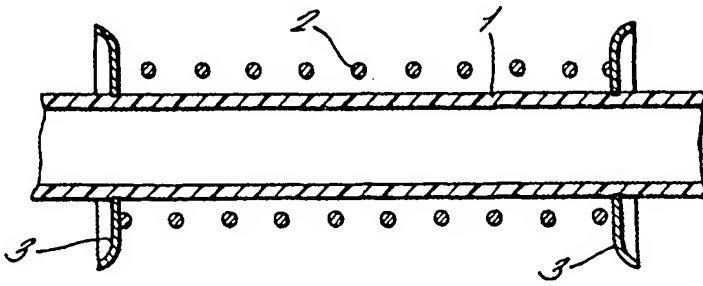


PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁷ : G01N 17/00</p>	<p>A1</p>	<p>(11) International Publication Number: WO 00/55598 (43) International Publication Date: 21 September 2000 (21.09.00)</p>
<p>(21) International Application Number: PCT/GB00/00959 (22) International Filing Date: 15 March 2000 (15.03.00) (30) Priority Data: 9906014.7 16 March 1999 (16.03.99) GB (71) Applicant (for all designated States except US): MASSTECH INTERNATIONAL LIMITED [GB/GB]; 20 Pensford Close, Crowthorne, Berkshire RG45 6QR (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): BRIDGES, Robert [GB/GB]; 20 Pensford Close, Crowthorne, Berkshire RG45 6QR (GB). (74) Agent: BOULT WADE TENNANT; Verulam Gardens, 70 Gray's Inn Road, London WC1X 8BT (GB).</p>	<p>(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report.</p>	
<p>(54) Title: A DEVICE FOR DETECTING THE PRESENCE OF A CHEMICAL CONTAMINANT</p> <p>(57) Abstract</p> <p>The disclosure relates to a device for detecting the presence of a chemical contaminant. The device comprising a resilient indicator element (2, 6) which is biased into a first position and is anchored in the first position by means of a failure element (1, 5). The failure element is made of a material which fails in the presence of a chemical to be detected, thereby releasing the indicator element from its first position and allowing it to move under its own resilience into a second position in order to provide an indication of the presence of the contaminant.</p> 		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LJ	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

A DEVICE FOR DETECTING THE
PRESENCE OF A CHEMICAL CONTAMINANT

5 The present invention relates to a device such as
an indicator, switch or actuator for detecting the
presence of a chemical contaminant. Such a detector
is used, for example, in filling stations and chemical
plants to detect the presence of unwanted chemicals.

10 Chemical detection devices are frequently
electronic and therefore have to be designed to be
intrinsically safe making them prohibitively expensive
for many applications and are dependent on the
15 reliability of the power supply. Further, recent
surveys in filling stations have shown that many of
these devices have been physically disabled or no
longer function for other reasons.

20 The present invention aims to provide a low cost,
disposable device which does not require electricity.

 According to a first aspect of the present
invention there is provided a device for detecting the
25 presence of a chemical contaminant, the device
comprising an indicator element which is held in a
first position by means of a failure element which is
held in tension, the failure element being made of a
material which fails in the presence of the chemical
30 to be detected, thereby releasing the indicator
element from its first position and allowing it to
move into a second position in order to provide an
indication of the presence of the contaminant.

35 According to a second aspect of the present
invention, which may be independent of, or used in

conjunction with the first aspect of the invention,
there is provided a device for detecting the presence
of a chemical contaminant, the device comprising a
resilient indicator element which is held in a first
5 position and is anchored in the first position by
means of a failure element, the failure element being
made of a material which fails in the presence of the
chemical to be detected, thereby releasing the
indicator element from its first position and allowing
10 it to move into a second position in order to provide
an indication of the presence of the contaminant;
wherein the failure element is elongate in the sense
that it is larger in the direction in which the
indicator element moves on failure of the failure
15 element than it is in any other dimension.

The device is based on simple chemistry and
therefore cannot fail to work upon contact with the
chemical to be detected. The device can be made very
20 simple in construction allowing it to be produced very
cheaply.

At present, when monitoring wells, it is
necessary to take a sample from every well to
25 determine whether or not contamination has occurred.
With the present invention it would only be necessary
to take samples from wells where the element has
failed.

30 With the first aspect of the invention, as the
failure element is held in tension, a failure, no
matter how small, anywhere along the failure element,
will cause the device to indicate the presence of a
contaminant.

35 With the second aspect of the invention, as the
failure element is elongate (for example, the length

of the failure element in the direction in which the indicator element moves on failure is at least 3 . times, preferably at least 10 times, more preferably at least 20 times, and most preferably at least 50 times its size in any other dimension), it can be extended across a zone in which chemical contaminant is to be detected, thereby providing a cost effective way of detection beyond a single location.

10 The indicator element may be held in the first position by a biasing force, the biasing force acting to move the indicator element to the second position upon failure of the failure element. Alternatively, the indicator element is held in the first position by
15 a biasing force and wherein a further force, which is strong enough to override the biasing force is arranged to act on the indicator element to move it to the second position upon failure of the failure element.

20 In its simplest form the indicator element is a spring which is fixed to the failure element, the spring being under compression, such that the failure element is under tension. The failure element is
25 preferably a tubular member. In order to provide a further degree of monitoring of the condition of the failure element, the tubular member is preferably sealed, the inside of the tubular member is maintained at a pressure other than atmospheric, and means are
30 provided to monitor this pressure to determine the integrity of the tubular member. In order to operate a valve, a cable can pass through the tubular member and be fixed to one end of the spring such that, on failure of the failure element the cable is pulled
35 through the tubular member to operate the valve. The spring is preferably attached to the failure element by a respective washer at each end of the spring, each

- 4 -

washer being anchored to the failure element so as to be capable of movement in only one direction along the failure element. This allows the indicator element to be fastened in place with the necessary preload by pushing each washer along the failure element. The washer will then be held in place as the spring will tend to urge it in the direction in which it cannot move.

10 In order to assist with an assessment of the full extent of a chemical contaminant, the failure element is preferably made of a material which changes its appearance in the presence of the contaminant.

15 Preferably, the failure element is a tubular element and the indicator element is within the tubular element and is fixed at one end to the failure element, while its other end projects beyond the other end of the failure element and is biased away from the other end of the failure element.

20 The further force may be any type of force, such as a magnetic force. However, preferably, the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.

25 In an alternative arrangement the indicator element comprises a core surrounded by a sleeve, the sleeve being biased away from the core, wherein the failure element holds the sleeve in a position in which it surrounds the core, whereby, when the failure element fails, the sleeve is released and moved away from the core providing a visual indication of the presence of the contaminant. Preferably, the outer surface of the sleeve is a different colour from the outer surface of the core, thereby improving the

visual indication of the presence of a contaminant.

In addition to the provision of visual indication, the device can also be arranged to operate
5 some failsafe mechanism to prevent further contamination, such as by automatically closing a valve.

In its simplest form, the failure element is made
10 of a single material which fails in the presence of a single contaminant. However, more complex devices are envisaged where the failure element comprises a number of different materials arranged in series and/or in parallel. With different materials arranged in
15 series, the device will operate when any one of a number of contaminants to which a single material is responsive, is present. A parallel arrangement, on the other hand, will only fail when contaminants to which all of the materials are responsive are present.
20 With a combination of series and parallel materials, a device can be tailored to detect a sophisticated selection of contaminants.

In order to detect the presence of a contaminant,
25 several of the devices described above are arranged over the area, preferably in parallel. This allow a map of the location and extent of a contaminant to be created.

30 Examples of devices constructed in accordance with the present invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a schematic cross-section of a first
35 example;

Fig. 2 is a cross-section of a second example;

Fig. 3 is a cross-section of a ground water monitoring well having a device according to the present invention;

5

Fig. 4 shows a device according to the present invention positioned under a tank in order to monitor leakage from the tank;

10

Fig. 4A is a detail of the part ringed as 4A in Fig. 4; and

15

Fig. 5 is a schematic plan view showing the operation of Fig. 4 to determine the full extent of contaminant leakage.

20

25

30

35

The device shown in Fig 1 comprises a tubular member 1 of high-density polystyrene. Attached to the tubular member 1 is a spring 2 which is held in compression by a pair of starlock washers 3 which anchor it to the tubular member 1. In the presence of a chemical contaminant, in this case any petroleum product, the tubular member 1 will fail and the spring 2 extends. The extension of the spring can be used to trigger a mechanical signal or alarm, or can close valves. A cable, such as a bowden cable, may extend through the tubular element and be fixed to one end of the starlock washers. On failure of the tubular member, the cable will be pulled through the tubular element allowing operation of a valve. The failure made may be shearing, stretching or bending of the tubular member, but is more likely to be slippage of a starlock washer when the surface of the tubular member has been degraded by the contaminant.

A second example is shown in Fig 2. In this case, the device is built around a central rod 4 on

which are threaded three failure elements 5 of expanded polystyrene, and a resilient indicator element 6. The failure elements 5 and resilient indicator element 6 are held in place by a pair of starlock washers 7. The resilient indicator element 6 comprises a sleeve 8 surrounding a core 9. The sleeve 8 and core 9 are biased away from one another by compression spring 10. When any one of the failure elements 5 fails in the presence of a chemical contaminant, the compression of spring 10 forces the sleeve 8 and core 9 axially away from one another, so that the outer surface of the core 9 is uncovered providing a visual indication that failure has occurred.

15

A third example is shown in Fig. 3. This shows a device used in a ground water monitoring well which is buried below ground level 11. The well comprises a slotted or perforated well casing 12 closed at its top end by a well monitoring cap 13. In this case, the failure element 14 is a tubular member which is suspended from the cap 13 and fixed at its bottom end to a weight 15. The indicator element comprises an elongate rod 16 extending within the failure element 14 and attached at its lower end to the weight 15, and a spring 17 mounted in the cap 13 and acting to bias the rod 16 upwardly.

The lower part of the well is filled with ground water 18. If a chemical contaminant 19 is present floating on the ground water 18, this will react chemically with the failure member 14 causing it to fail. At this time, the full mass of the weight 15 is held by the rod 16 which will be pulled downwardly under gravity compressing spring 17 and providing a visual indication at the well cap of the presence of the contaminant.

35

When monitoring a well, the device could be several metres long, so that no matter at what level the hydrocarbon contaminant existed, the element would fail.

A fourth example is shown in Figs. 4, 4A and 5. This example is designed to detect leakage from a tank 20. A plurality of elongate devices are buried in the ground 21 beneath the tank 20. Fig. 4 shows one such indicator, and the arrangement of all of the indicators is shown in plan in Fig. 5. The device comprises a perforated tube 22 containing elongate failure element 23 which projects from one end of the perforated tube 22 and is fastened at the other end of the tube 22. A spring 24 providing the indicator element is provided to bias a starlock washer 25 attached to the end of the failure element 23 away from a washer 26 at the end of the perforated tube 22 hence holding the failure element in tension.

When a chemical contaminant 27 leaks from the tank 20, it will enter the perforated tubes 22 immediately below the leak and will cause certain failure elements 23 to fail. Once a failure element 23 fails at any location, the spring 24 which is held in compression, will push the starlock washer 25 away from the end of the tube 22 thereby providing a visual indication of the presence of a contaminant. Once a contaminant is detected, all of the failure elements 23 can be pulled out and inspected. If they are made of a material which changes its appearance or is entirely obliterated in the presence of the contaminant, it is possible to build up a map showing the location and extent of the contaminant 27 as shown in Fig. 5.

CLAIMS:

1. A device for detecting the presence of a chemical
contaminant, the device comprising an indicator
5 element which is held in a first position by means of
a failure element which is held in tension, the
failure element being made of a material which fails
in the presence of the chemical to be detected,
thereby releasing the indicator element from its first
10 position and allowing it to move into a second
position in order to provide an indication of the
presence of the contaminant.
2. A device according to claim 1, wherein the
15 indicator element is held in the first position by a
biasing force, the biasing force acting to move the
indicator element to the second position upon failure
of the failure element.
- 20 3. A device according to claim 2, wherein the
biasing force is provided by the resilience of the
indicator element.
- 25 4. A device according to claim 3, wherein the
resilient indicator element is a spring which is fixed
to the failure element, the spring being under
compression, such that the failure element is under
tension.
- 30 5. A device according to any preceding claim,
wherein the failure element is a tubular member.
6. A device according to claim 5, wherein the
tubular member is sealed, the inside of the tubular
35 member is maintained at a pressure other than
atmospheric, and means are provided to monitor this
pressure to determine the integrity of the tubular

member.

- 5 7. A device according to any one of claims 4 to 6, wherein the spring is attached to the failure element by a respective starlock washer at each end of the spring each washer being anchored to the failure element so as to be capable of movement in only one direction along the failure element.
- 10 8. A device according to any one of the preceding claims, wherein the failure element is made of a material which changes its appearance in the presence of the contaminant.
- 15 9. A device according to claim 1, wherein the indicator element is held in the first position by a biasing force and wherein a further force, which is strong enough to override the biasing force is arranged to act on the indicator element to move it to
20 the second position upon failure of the failure element.
- 25 10. A device according to claim 9, wherein the failure element is a tubular element and the indicator element is within the tubular element and is fixed at one end to the failure element, while its other end projects beyond the other end of the failure element and is biased away from the other end of the failure element.
- 30 11. A device according to claim 9, wherein the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.
- 35 12. A device according to any one of the preceding claims, wherein the failure element comprises a number

- 11 -

of different materials arranged in series and/or in parallel.

13. A device for detecting the presence of a chemical
5 contaminant, the device comprising a resilient
indicator element which is held in a first position
and is anchored in the first position by means of a
failure element, the failure element being made of a
10 material which fails in the presence of the chemical
to be detected, thereby releasing the indicator
element from its first position and allowing it to
move into a second position in order to provide an
indication of the presence of the contaminant; wherein
15 the failure element is elongate in the sense that it
is larger in the direction in which the indicator
element moves on failure of the failure element than
it is in any other dimension.

14. A device according to claim 13, wherein the
20 failure element is held in tension.

15. A device according to claim 13 or claim 14,
wherein the indicator element is held in the first
position by a biasing force, the biasing force acting
25 to move the indicator element to the second position
upon failure of the failure element.

16. A device according to claim 15, wherein the
biasing force is provided by the resilience of the
30 indicator element.

17. A device according to claim 16, wherein the
resilient indicator element is a spring which is fixed
to the failure element, the spring being under
35 compression, such that the failure element is under
tension.

18. A device according to any one of claims 13 to 17, wherein the failure element is a tubular member.

5 19. A device according to claim 18, wherein the tubular member is sealed, the inside of the tubular member is maintained at a pressure other than atmospheric, and means are provided to monitor this pressure to determine the integrity of the tubular member.

10 20. A device according to any one of claims 17 to 19, wherein the spring is attached to the failure element by a respective starlock washer at each end of the spring each washer being anchored to the failure
15 element so as to be capable of movement in only one direction along the failure element.

21. A device according to any one of claims 13 to 20, wherein the failure element is made of a material
20 which changes its appearance in the presence of the contaminant.

22. A device according to claim 13, wherein the indicator element is held in the first position by a
25 biasing force and wherein a further force, which is strong enough to override the biasing force is arranged to act on the indicator element to move it to the second position upon failure of the failure element.

30 23. A device according to claim 22, wherein the failure element is a tubular element and the indicator element is within the tubular element and is fixed at one end to the failure element, while its other end
35 projects beyond the other end of the failure element and is biased away from the other end of the failure element.

24. A device according to claim 23, wherein the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.

5

25. A device according to any one of claims 13 to 24, wherein the length of the failure element in the direction in which the indicator element moves on failure is at least 3 times, preferably at least 10
10 times, more preferably at least 20 times, and most preferably at least 50 times its size in any other dimension.

26. A device according to any one of claims 13 to 25,
15 wherein the failure element comprises a number of different materials arranged in series and/or in parallel.

27. An arrangement for detecting the presence of a
20 chemical contaminant over a predetermined area, the arrangement comprising a plurality of devices according to any one of the preceding claims arranged over the area.

28. An arrangement according to claim 27, wherein the
25 devices are arranged substantially in parallel.

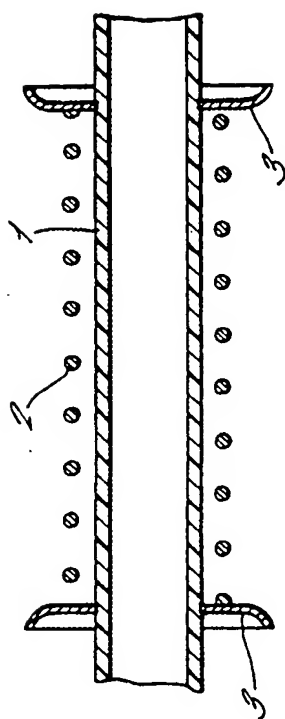


FIG. 1

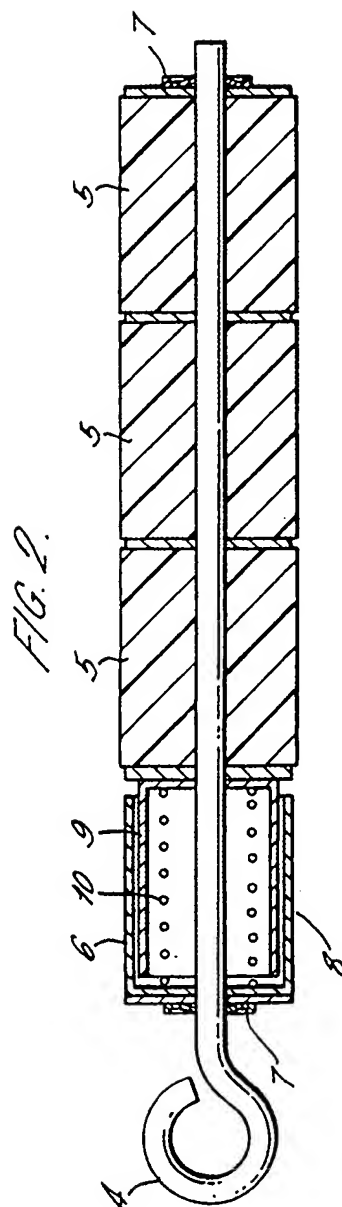


FIG. 2

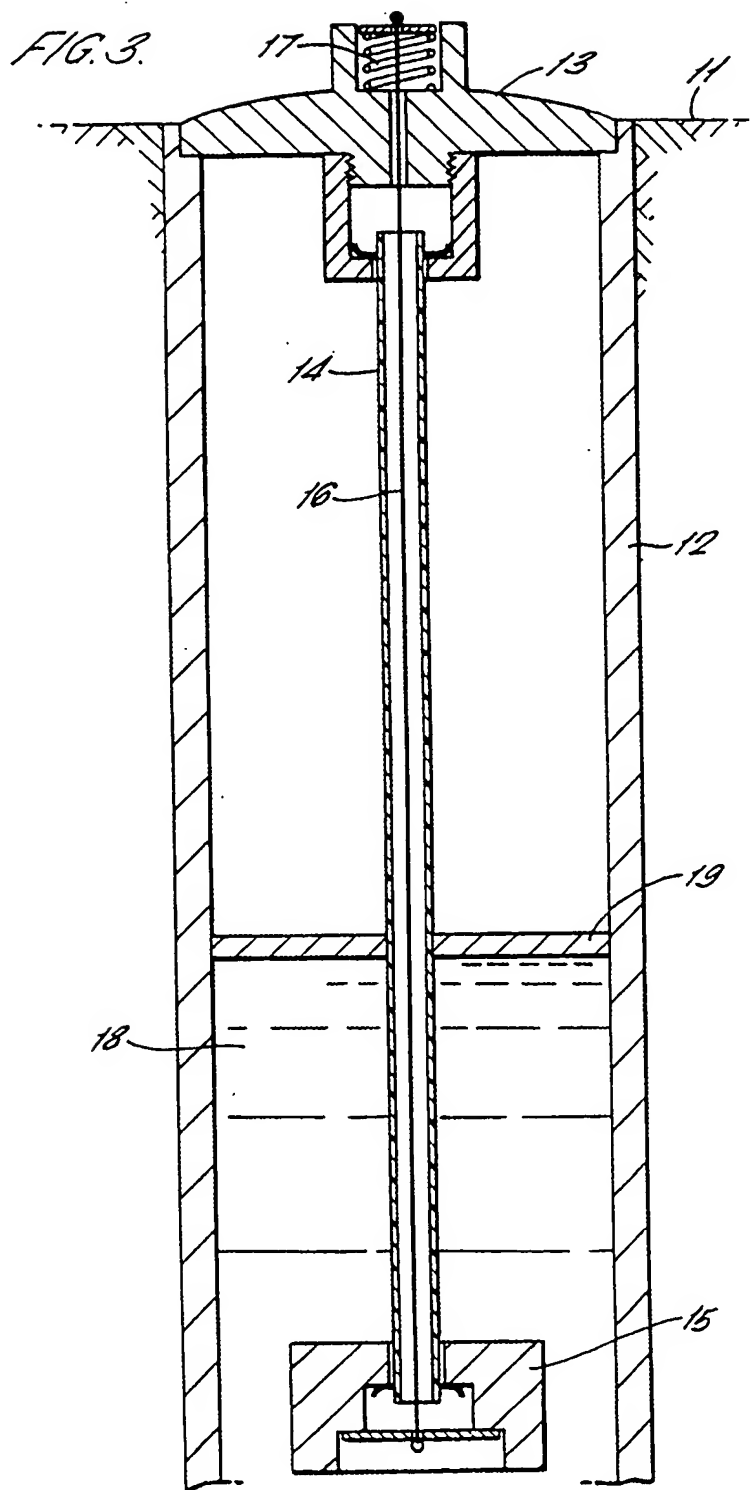


FIG. 4.

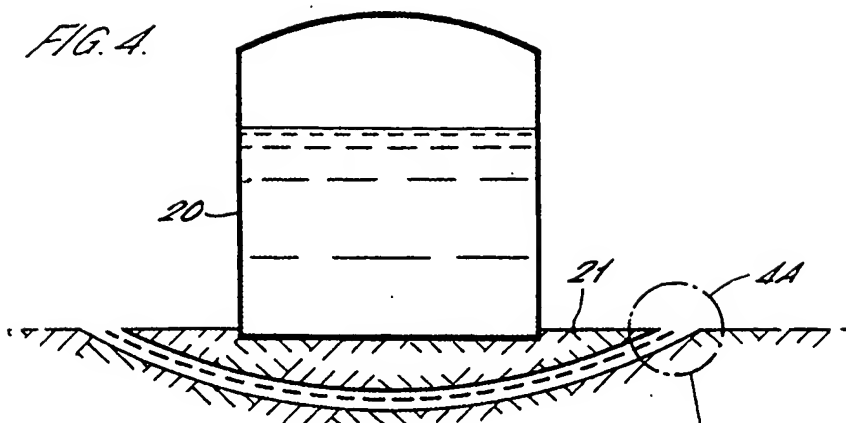


FIG. 4A.

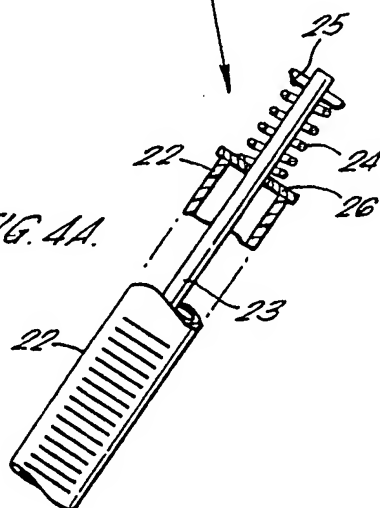
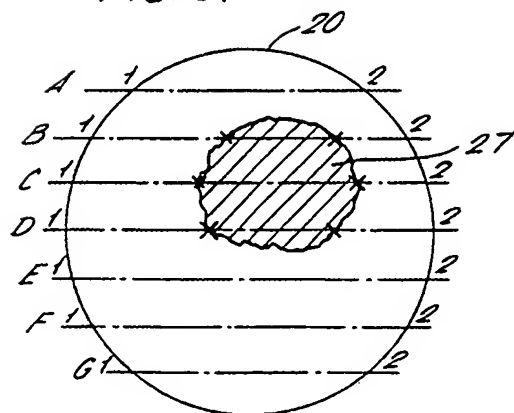


FIG. 5.



INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/00959

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G01N17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 846 795 A (JONES C) 5 November 1974 (1974-11-05) column 3 -column 4; figure 1	1-28
A	WO 88 01052 A (UNIV MANCHESTER) 11 February 1988 (1988-02-11) figure 1	1-28
A	US 4 628 252 A (TERHUNE JAMES H ET AL) 9 December 1986 (1986-12-09) figure 1	1-28
A	US 5 728 943 A (RIZZO FRANK E ET AL) 17 March 1998 (1998-03-17). figures 1,2	1-28
	--- -/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"8" document member of the same patent family

Date of the actual completion of the international search

22 May 2000

Date of mailing of the international search report

30/05/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5816 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Mason, W

1

INTERNATIONAL SEARCH REPORT

Int. .ional Application No
PCT/GB 00/00959

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 271 120 A (MICHAUD LOUIS M) 2 June 1981 (1981-06-02) figure 1 ---	1-28
A	FR 2 704 318 A (RENAULT VEHICULES IND) 28 October 1994 (1994-10-28) figure 1 ---	1-28
A	PATENT ABSTRACTS OF JAPAN vol. 006, no. 148 (P-133), 7 August 1982 (1982-08-07) & JP 57 067843 A (TOKYO KOKI SEIZOSHO:KK), 24 April 1982 (1982-04-24) abstract ---	1-28
A	US 4 335 615 A (KALFA HORST ET AL) 22 June 1982 (1982-06-22) figure 1 ---	1-28
A	US 4 237 972 A (LANMON C P II) 9 December 1980 (1980-12-09) figures 3,4 -----	1-28

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/00959

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3846795 A	05-11-1974	DE 2351368 A FR 2205698 A IT 996906 B JP 49077098 A	16-05-1974 31-05-1974 10-12-1975 25-07-1974
WO 8801052 A	11-02-1988	AU 7692387 A EP 0317558 A GB 2215849 A, B	24-02-1988 31-05-1989 27-09-1989
US 4628252 A	09-12-1986	DE 3444875 A ES 538292 D ES 8705628 A IT 1177296 B JP 1893562 C JP 6014009 B JP 60168039 A SE 461301 B SE 8406290 A	20-06-1985 01-05-1987 16-07-1987 26-08-1987 26-12-1994 23-02-1994 31-08-1985 29-01-1990 13-06-1985
US 5728943 A	17-03-1998	NONE	
US 4271120 A	02-06-1981	CA 1076894 A	06-05-1980
FR 2704318 A	28-10-1994	NONE	
JP 57067843 A	24-04-1982	JP 1416551 C JP 62023811 B	22-12-1987 25-05-1987
US 4335615 A	22-06-1982	EP 0020852 A JP 56035040 A	07-01-1981 07-04-1981
US 4237972 A	09-12-1980	NONE	